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BRIEF REPORT

Walking With a Rollator and the Level of Physical Intensity in Adults 75 Years of Age or Older

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ABSTRACT. Eggermont LH, van Heuvelen MJ, van Keeken BL, Hollander AP, Scherder EJ. Walking with a rollator and the level of physical intensity in adults 75 years of age or older. Arch Phys Med Rehabil 2006;87:733-6.

Objective: To determine whether walking with a rollator by persons 75 years of age or older is of sufficient intensity to improve aerobic fitness.

Design: A cross-sectional cohort study.

Setting: University movement laboratory.

Participants: Fifteen subjects 75 years of age or older (mean age, 83.7y) who could only walk by using a rollator.

Interventions: Not applicable.

Main Outcome Measures: During 6 minutes of self-paced treadmill walking using a rollator at a mean walking speed of 0.6m/s, oxygen uptake ($\dot{V}O_2$), carbon dioxide production, and heart rate were determined. Respiratory exchange ratio (RER) and energy expenditure were calculated. The energy expenditure was expressed as the number of metabolic equivalents (METS), the percentage of estimated maximal $\dot{V}O_2$ ($\dot{V}O_2max$), the percentage of estimated $\dot{V}O_2max$ reserve, and the percentage of estimated maximal heart rate.

Results: Mean $\dot{V}O_2$ was .718L/min. Mean RER was .93 (95% confidence interval [CI], .89−.97). Thirteen participants showed an RER below 1.0, which indicates a negligible contribution of anaerobic expenditure. Walking with a rollator required a mean of 2.8 (95% CI, 2.4−3.2) METS, 71.9% of $\dot{V}O_2max$ (95% CI, 65.2%−78.6%), 50.5% (95% CI, 39.4%−61.5%) of $\dot{V}O_2$ reserve, and 75.2% (95% CI, 67.6%−82.8%) of estimated maximal heart rate.

Conclusions: For people 75 years of age or older, walking with a rollator is an activity of moderate to high level of intensity, with the capacity of improving aerobic fitness.

Key Words: Aerobic exercise; Energy expenditure; Frail elderly; Rehabilitation.

THERE IS INCREASING EVIDENCE of a positive relation between physical activity, physiologic parameters such as blood pressure, functional abilities, balance, flexibility, muscle strength, and cognitive functioning in older adults.[1-6] Cognitive functions are particularly vulnerable to aging[7] and are crucial for independent living.[8]

Older adults with a decrease in physical activity caused by poor cardiorespiratory condition have experienced greater cognitive decline over a period of 6 years compared with older adults showing high cardiorespiratory fitness.[9] In healthy, sedentary older subjects, aerobic activities resulted in a significant improvement in the maximal oxygen uptake ($\dot{V}O_2max$) and to benefit executive functions such as inhibition and planning.[10] These studies, however, involved high-intensity physical activity such as running.[10] This type of physical activity is usually not appropriate for people of advanced age.[11] It is known that physical fitness (eg, muscle strength, balance) decreases with age.[12] Consequently, many of the oldest old (age >75y) can only stay mobile by the use of a walking aid[13] and are unable to run. In 1 study,[14] more than half of the 599 subjects aged 75 or over who were surveyed owned 1 or more walking devices. In sum, for frail older people, walking with a device like a rollator is a much more appropriate activity than activities such as running.

In view of the effects of aerobic activity on for instance executive functions, it is important to know the exact amount of energy expended when walking with a rollator and does this constitute adequate aerobic activity. This has not been examined before. According to the guidelines of the American College of Sports Medicine (ACSM),[15] activities with an intensity of 55% to 65% of maximal heart rate or 40% to 50% of $\dot{V}O_2max$ reserve ($\dot{V}O_2max$ minus resting $\dot{V}O_2$) are appropriate to increase or maintain cardiorespiratory fitness of relatively unfit persons provided that the frequency is at least 3 times a week and the duration at least 30 minutes per occasion. We studied this treatment frequency and duration in a recent pilot study[16] in which the effects of walking with a rollator on executive functions were examined in persons with mild cognitive impairment. After a treatment period of 6 weeks, verbal fluency, a task that relies on executive control functions,[17] improved. Firm conclusions about the effectiveness of walking with a rollator on executive functions can, however, not be drawn. First, the range of executive functions examined in that study was restricted (only 2 tasks). Second, it was not examined whether walking with a rollator is intense enough to increase aerobic activity. The objective of the present study was to determine the physical intensity of walking with a rollator.

METHODS

Participants

The study sample consisted of 15 subjects 75 years or older (12 women, 3 men) who lived in a residential home (n=13) or at home (n=2). The mean age was 83.7±4.6 years. The level of cognitive functioning was assessed by means of the Mini-Mental State Examination (MMSE).[18] Mean MMSE score was 25.21±2.6. Mean body weight was 75.0±15.2kg. All participants signed informed consent.

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Inclusion and exclusion criteria. Medical staff of the residential home and the general practitioner were consulted and participants were included in the study if (1) they were 75 years or older, (2) they were able to walk only by means of a rollator, (3) they had a normal mental status by using norms of a sample of cognitively unimpaired older persons controlling for age,[19] and (4) they were able to walk 20m to determine walking speed. Participants were excluded from the study if they were suffering from a neurodegenerative disease that would cause motor impairment such as Parkinson's disease.[20]

Comorbidity. Participants' medical history showed: cardiac problems (n=8), diabetes mellitus (n=2), cerebral ischemic attack (n=5), exanthema (n=2), diverticulosis (n=3), rheumatic arthritis (n=8), osteoporosis (n=5), gout (n=2), hernia nuclei pulposi (n=4), radiculopathy (n=2), spondylodesis (n=2), polymyalgia rheumatica (n=1), pulmonary disease (n=5), cholecystectomy (n=1), tumors (n=1), appendectomy (n=3), cystitis (n=1), pyelitis (n=1), hypercholesterolemia (n=1), hyperthyroidism (n=1), and visual disturbances (n=5). The comorbidities in our sample were representative of the general population of this age.[21]

Procedure

The participants walked with their rollator for 6 minutes on a treadmill.[a] Each participant's walking velocity was determined by measuring the time needed to walk 20m on a regular flat surface at his/her comfortable speed. Because walking speed was determined over a short distance, the speed of the treadmill was set at a 10% reduction of the initially determined speed. Participants were asked to practice on the treadmill for a short period of time to get accustomed to the treadmill. Participants walked at a mean walking speed of .64±.10m/s.

Measurement

Oxygen consumption during walking was determined by use of Oxycon Alpha.[b] This system consists of a soft mask to sample exhaled air and a sensor system that continuously measures expired ventilation, oxygen use ($\dot{V}O_2$), and carbon dioxide production ($\dot{V}CO_2$). From the 6-minute walk, the averages of the last 2 minutes were used to determine the outcome parameters in a steady-state condition.

Oxygen uptake. $\dot{V}O_2$ (in L/min) and $\dot{V}O_2$ per kilogram of body weight (in $mL \cdot min^{-1} \cdot kg^{-1}$) were determined. Percentage of estimated $\dot{V}O_2max$ (%$\dot{V}O_2max$) was determined by using predicted values from the literature. These values were derived from regression equations of the relation between age and $\dot{V}O_2max$ for men and women aged 55 to 86 years.[22] These equations include the following: for men: $\dot{V}O_2max$ (L/min)$=-0.034\times age+4.142$ or $\dot{V}O_2max$ ($mL \cdot min^{-1} \cdot kg^{-1}$)$=-0.31\times age+44.23$ and for women: $\dot{V}O_2max$ (L/min)$=-0.019\times age+2.518$ or $\dot{V}O_2max$ ($mL \cdot min^{-1} \cdot kg^{-1}$)$=-0.25\times age+36.63$. In addition, percentage of estimated $\dot{V}O_2max$ reserve was calculated by the the following formula: ($\dot{V}O_2-$resting $\dot{V}O_2$)/($\dot{V}O_2max-$resting $\dot{V}O_2$)$\times$100%, using resting $\dot{V}O_2=3.5mL \cdot min^{-1} \cdot kg^{-1}$.

Respiratory exchange ratio. The respiratory exchange ration (RER) was calculated by dividing $\dot{V}CO_2$ by $\dot{V}O_2$ to determine whether walking with a rollator is an aerobic activity. An RER of 1.0 or below 1.0 indicates aerobic expenditure with a negligible contribution of anaerobic expenditure.[23] In aerobic activity, the aerobic metabolic pathways are sufficient to meet the energy demands of the muscles and the participant can sustain the activity for a prolonged time period without exhaustion.[24] When exercise is performed at higher work rates, anaerobic pathways are increasingly used to meet energy demands, decreasing the length of time that activity can be sustained. These anaerobic processes go together with the accumulation of lactate. The buffering of the lactate adds extra carbon dioxide to the expired air and the RER will exceed 1.0.[24]

Energy expenditure. The energy expenditure (in J/s) was determined by the following formula: $\dot{V}O_2$ (L/s)$\times$(16,040$+$RER$\times$4940).[25] Energy expenditure per meter and energy expenditure per meter per kilogram of body weight (in $J \cdot m^{-1} \cdot kg^{-1}$) were determined as well. The intensity of the activity was also expressed as the number of metabolic equivalent units (METS). One MET is generally assumed to be $3.5mL \cdot min^{-1} \cdot kg^{-1}$.[26]

Heart rate. Measurement of heart rate (with a 5-second interval) was determined by use of a sports tester.[c] Percentage of maximal heart rate was determined by the following formula: heart rate/(220$-$age)$\times$100%.

RESULTS

Oxygen Uptake

The mean $\dot{V}O_2$ was .718L/min. Mean $\dot{V}O_2$ per kilogram of body weight was $9.89mL \cdot kg^{-1} \cdot min^{-1}$ (table 1). By using the linear regression equations from the literature,[22] participants walked on average at 61.2% (95% confidence interval [CI], 52.5%$-$69.9%) of the estimated $\dot{V}O_2max$ expressed in $mL \cdot min^{-1} \cdot kg^{-1}$ and 71.9% (95% CI, 65.2%$-$78.6%) of the estimated $\dot{V}O_2max$ expressed in liters per minute (for means and standard deviations, see table 1). Expressed as a percentage of $\dot{V}O_2max$ reserve, the participants walked at 50.5% (95% CI, 39.4%$-$61.5%).

Energy Expenditure

The mean energy expenditure and energy expenditure per meter were 246.73J/s and 395.76J/m, respectively. Mean energy expenditure per kilogram of body weight was $5.39J \cdot m^{-1} \cdot kg^{-1}$. Mean intensity was 2.8 (95% CI, 2.4$-$3.2) METS (see table 1).

Respiratory Exchange Ratio

Mean RER was .93 (95% CI, .89$-$.97). Thirteen participants showed an RER below 1.0. Two participants had an RER above 1.0 (1.02, 1.10).

Heart Rate

On average, participants reached a heart rate of 75.2% (95% CI, 67.6%$-$82.8%) of the estimated maximal heart rate.

DISCUSSION

The goal of this study was to determine the amount of energy expended when walking with a rollator. We found that this group of subjects, 75 years of age or older, consumed an average of 2.8 METS when walking; this corresponds to a moderate level of intensity according to the ACSM scale for the very old.[15] Compared with activities taken from the Compendium of Physical Activities,[27] walking with a rollator is a somewhat higher-intensity activity than vacuum cleaning and a somewhat lower-intensity activity than walking down stairs. In our study, we did not measure the resting $\dot{V}O_2$; therefore, an MET was considered to be $3.5mL \cdot min^{-1} \cdot kg^{-1}$.[26] However, for older people this may be an overestimate.[26]

Thirteen participants showed an RER below 1.0, indicating aerobic expenditure. Two participants had an RER above 1.0. One of them showed more exertion and walked at the highest speed of all participants. The other participant appeared very anxious during the walk on the treadmill and did not finish the

Table 1: Raw Data for Each Subject

Subjects	Walking Speed (m/s)	$\dot{V}O_2$ (L/min)	$\dot{V}O_2$ (mL·min^{-1}·kg^{-1})	$\dot{V}CO_2$ (L/min)	RER	%$\dot{V}O_2$max (L/min)	%$\dot{V}O_2$max (mL·min^{-1}·kg^{-1})	%$\dot{V}O_2$ Reserve	Energy Expenditure (J/s)	Energy Expenditure (J/m)	Energy Expenditure (J·m^{-1}·kg^{-1})	METS	HR (beats/min)	%HRmax
1	0.65	0.95	14.03	0.81	0.86	71.58	75.82	70.18	319.49	491.52	7.34	4.01	95	69.34
2	0.61	0.50	5.44	0.48	0.96	56.79	35.94	16.66	173.74	284.82	3.10	1.55	119	88.81
3	0.61	0.53	8.47	0.59	1.10	67.64	61.04	47.91	190.92	312.98	4.97	2.42	127	98.45
4	0.72	0.95	10.71	0.89	0.94	70.07	56.96	47.12	327.23	454.48	5.11	3.06	95	68.84
5	0.45	0.97	11.02	0.97	0.99	101.35	68.32	59.55	339.78	755.06	8.58	3.15	81	58.70
6	0.67	0.57	10.88	0.50	0.88	75.08	81.33	74.72	191.70	286.11	5.50	3.11	86	67.72
7	0.68	0.72	14.03	0.59	0.82	76.78	88.38	85.09	241.76	355.53	6.84	4.01	98	71.53
8	0.51	0.57	9.50	0.50	0.87	68.32	66.07	55.16	191.45	375.40	6.26	2.71	114	87.02
9	0.75	0.69	8.15	0.65	0.95	72.90	51.35	37.60	237.14	316.19	3.76	2.33	87	63.50
10	0.85	0.75	13.77	0.75	1.02	74.66	82.78	78.19	261.59	307.75	5.70	3.93	132	94.29
11	0.65	0.59	7.01	0.55	0.94	62.51	44.15	28.36	202.64	311.75	3.71	2.00	82	59.85
12	0.50	0.75	9.41	0.70	0.94	77.71	58.31	46.76	257.01	514.02	6.51	2.69	85	61.59
13	0.62	0.79	9.34	0.73	0.94	71.95	52.24	40.61	270.96	437.03	5.20	2.67	115	79.31
14	0.65	0.69	8.07	0.61	0.89	47.36	40.87	28.13	234.61	360.94	4.20	2.31	132	93.62
15	0.70	0.78	8.49	0.65	0.85	84.00	54.31	41.13	260.94	372.78	4.10	2.43	89	65.44
Mean*	0.64±0.10	0.72±0.15	9.89±2.56	0.67±0.15	0.93±0.07	71.91±12.08	61.19±15.79	50.48±19.92	246.73±52.29	395.76±123.49	5.39±1.52	2.83±0.73	102.47±18.74	75.20±13.77

*Values are mean ± standard deviation of the measurements during the 6-minute walk.

Abbreviations: HR, heart rate; %HRmax, percentage of maximal heart rate.

6 minutes because of this anxiety. For this participant, the high RER may be related to hyperventilation. Combining this with the fact that all other participants had an RER lower than 1.0 suggests that walking with a rollator is an aerobic activity of a moderate- to high-intensity level.

According to the ASCM guidelines,[15] activities with an intensity corresponding to 55% to 65% of maximal heart rate or 40% to 50% of $\dot{V}O_2$max reserve are appropriate for increasing or maintaining cardiorespiratory fitness in relatively unfit older persons. Walking with a rollator yields an intensity corresponding to 75% of the maximal heart rate and 50% of the $\dot{V}O_2$max reserve and therefore meets these criteria. However, the criteria further stipulate that activity of this intensity must be performed at least 3 times a week for at least 30 minutes a session.[15] In the aforementioned pilot study,[16] this treatment frequency and duration were successfully applied to subjects 75 years and older who walked with a rollator. Training with a rollator is inexpensive and widely feasible. As well, self-paced walking has been reported to be preferred over activities such as bicycling and swimming in this age group.[28]

Energy expenditure during walking with assistive devices such as crutches or a walker has, so far, been examined only in younger people, and the results are inconsistent. One study[29] showed that walking with crutches resulted in lower $\dot{V}O_2$ compared with walking with a rollator or a standard walker. Compared with unassisted walking, walking with a wheeled walker resulted in more oxygen use.[29] In another study,[30] however, there was no difference in $\dot{V}O_2$ between walking with or without a rollator. Comparison between those 2 studies and our study is difficult because the studies included younger participants, walking speed differed, and participants did not use a rollator in their daily life.

The previously mentioned finding of an energy expenditure of 2.8 METS may be an underestimation of the intensity of walking with a rollator. For future research, it is recommended that resting $\dot{V}O_2$ is measured to provide more accurate estimates of the intensity expressed in METS as well as the $\dot{V}O_2$max reserve. A second limitation of this study is that we estimated the $\dot{V}O_2$max by using predicted values from the literature[22] instead of participant scores of $\dot{V}O_2$max obtained from direct or indirect measurement. However, in this frail population, it may be difficult or even impossible to determine the $\dot{V}O_2$max directly. In 1 study,[31] less than 50% of a representative sample of older subjects aged 57 to 78 years succeeded in reaching their $\dot{V}O_2$max. As far as we know, exercise tests to determine or estimate the $\dot{V}O_2$max of the oldest old have not been developed yet. Another limitation of the study is the small sample size yielding wide CIs on the main outcome measures. Further research in a larger sample would yield more precise estimates and greater confidence in our conclusions.

Because walking with a rollator might improve executive functions in older people,[16] there is a need for further exploration of the applicability and possible benefits of this form of exercise. A broad range of cognitive indicators as well as functional outcomes need to be studied.

CONCLUSIONS

For people 75 years or older, walking with a rollator is an activity of a moderate to a high level of intensity, with sufficient capacity to improve aerobic fitness.

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